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REVIEW ARTICLE

Effect of different physical activities on erectile dysfunction in adult men not receiving phosphodiesterase-5 inhibitors therapy: A systematic review and meta-analysis

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Aerobic training alone improves the erectile function in males not using PDE5i. No enhancement with combined aerobic and resistance training or PFMT. Results emphasize exercise's impact on ED in non-PDE5i therapy users, especially with aerobic training alone.

Abstract

Background: Erectile dysfunction (ED) is prevalent not only among older males but also in younger. The physical activity has been considered a potential protective factor against ED. However, there is a lack of comprehensive research on the impact of exercise interventions specifically on ED patients.

Objectives: This study aimed to assess the effectiveness of the physical activity in addressing ED symptoms among adult males, without the use of the phosphodiesterase-5 inhibitors (PDE5i) therapy. Additionally, subgroup analysis was performed to evaluate the effects of different exercise modes.

Methods: Employing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, we conducted a systematic literature search. A registered protocol is available at PROSPERO (CRD42023441717). Our search spanned PubMed, Web of Science, Embase, and Cochrane Library, with data collection ending on 11 April 2024. The Cochrane Risk of Bias tool was applied by two independent authors to assess randomized controlled trial (RCT) quality. The primary endpoint was determined as the International Index of Erectile Function (IIEF) scores.

Results: A total of seven RCTs were included. Utilizing a random-effects model, the estimated standardized mean difference (SMD) was 0.69 (95% confidence interval [CI] 0.37 to 1.02, $p < 0.0001$) for the overall impact of the physical activity. Subgroup analysis revealed SMDs of 0.81 (95% CI 0.56 to 1.06; $p < 0.00001$) for aerobic training alone. However, no significant improvement was observed with pelvic floor muscle training (PFMT) (SMD 0.03; 95% CI −0.68 to 0.75; $p = 0.93$) and a combination of aerobic and resistance training (SMD 0.84; 95% CI −0.41 to 2.09; $p = 0.19$)

Conclusion: The findings of this study highlight a significant improvement in the erectile function following exercise interventions for adult men with ED, who are not receiving the PDE5i therapy, especially in conducting aerobic training alone. However, PFMT and a combination of aerobic and resistance training did not show significant improvements in erectile function from this study.

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KEYWORDS
erectile dysfunction, erectile function, exercise, IIEF, physical activity

1 | INTRODUCTION

Erectile dysfunction (ED), as defined by the International Consultation on Sexual Medicine consensus, refers to the consistent or recurrent inability to attain and/or maintain a penile erection sufficient for sexual satisfaction.[1] ED etiology is classified into organic, psychogenic, or mixed psychogenic and organic categories.[2] Presently, the International Index of Erectile Function (IIEF) and its abbreviated version, IIEF-5, are established as a tool to quantify ED to evaluate and treat patients. A meta-analysis focused on Asian populations has revealed an age-related increase in prevalence, with over half of men aged 50 years or older experiencing ED.[3] Notably, ED is not only prevalent in older men but also has an alarmingly high prevalence among younger men.[4] Recent research has indicated a rising prevalence of ED, up to 30% in men under 40 years old, as evidenced by a large multinational study.[5] ED was strongly associated with various diseases or conditions. For instance, ED is recognized as a complication of diabetes,[6] occurring 3.5 times more frequently in diabetic individuals than in those without diabetes.[7] Similarly, hypertension is linked to approximately twice the ED prevalence in comparison to normotensive individuals.[8] Moreover, a recent meta-analysis has indicated that cannabis use might elevate the prevalence of ED by fourfold compared to non-users.[9] Unhealthy lifestyle factors such as obesity, smoking, and alcohol consumption further increase the prevalence of ED in men.[10]

Medication and behavioral therapies are currently frontline conservative non-surgical treatments for ED.[11] Regarding the medication therapy, oral phosphodiesterase-5 inhibitors (PDE5i) are the preferred therapy for ED and are well tolerated in more than 70% of patients, including sildenafil, tadalafil, vardenafil, avanafil, lodenafil, mirodenafil, and udenafil.[12,13] Alternative treatments, including low-intensity extracorporeal shock wave therapy (Li-ESWT),[14] vacuum therapy,[15] and intracavernosal therapy,[16] have also demonstrated substantial therapeutic impact on the erectile function in clinical practice.

The benefits of regular exercise for the male erectile function have been reported by many studies. Several previous meta-analyses suggested that physical activity and exercise may enhance the erectile function in comparison to male patients with limited or no physical activity.[3,17,18] However, patients treated with oral PDE5i were not excluded from those meta-analyses, given the substantial efficacy of PDE5i in treating ED, the actual effect of the physical activity on ED improvement might be obscured, leading to possible bias in the results. Meanwhile, previous studies have not taken into account the possibility of spontaneous recovery of the erectile function in patients after radical prostatectomy. In addition, the effects of different exercises on the erectile function were not analyzed in subgroups. Consequently, this study aims to explore the efficacy of different physical activities on adult males with ED symptoms, excluding any influence of PDE5i therapy and patients who have undergone radical prostatectomy.

2 | METHODS

This study strictly followed the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[19] Furthermore, a comprehensive protocol detailing the methodology of this meta-analysis has been duly registered with PROSPERO under the registration number CRD42023441717.

2.1 | Search strategy and information source

We searched four electronic databases on 11 April 2024, including PubMed, Web of Science, Embase, and Cochrane Library. Search strategies were applied using the Medical Subject Headings and free words combining terms of the physical activity and ED.

2.2 | Study selection

The inclusion criteria were as follows: (a) adult male patients diagnosed with ED using the IIEF questionnaire at baseline; (b) the intervention group encompassed any form of exercise or physical activity, including pelvic floor muscle training (PFMT), aerobic training, and aerobic combined with resistance training, and others; (c) the control group was specified as not receiving exercise intervention, including usual care, maintaining a standard lifestyle, health education, or dietary adjustments; (d) evaluation of ED was conducted in male patients at endpoints using the IIEF; (e) studies presented complete text in English; (f) only randomized controlled trials (RCTs) were considered for inclusion.

Exclusion criteria were applied based on the following: (a) studies where both control and exercise groups received the PDE5i therapy; (b) studies with redundant publication; (c) the patients who underwent radical prostatectomy.

2.3 | Date extraction

Two independent researchers utilized standardized forms to extract data, encompassing authors, publication year, sample size at baseline and endpoint, mean or range of patient ages, predisposing factors for ED, details of control and exercise group protocols, measurement duration, measurement tools, and mean IIEF score at baseline.

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A third researcher reviewed the extracted data and resolved any disagreements.

2.4 | Quality assessment

The Cochrane risk of bias tool was used to assess the quality of included RCTs by two researchers. It contains six items to assess random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other biases. Any disagreement was solved by asking a third researcher to reassess or by consensus.

2.5 | Statistical analysis

The gathered data underwent analysis using Review Manager 5.4 software. Specifically, for this meta-analysis, solely continuous data were extracted and subjected to analysis. Consequently, we employed the mean difference (MD) or standardized mean difference (SMD) along with their respective 95% confidence intervals (CIs) as evaluation metrics for the included studies. To assess heterogeneity, both the I^2 statistic and Cochrane *Q* statistic were utilized in line with the guidance presented in the Cochrane Handbook. In particular, I^2 and the *p*-value derived from the *Q* statistic were utilized to assess heterogeneity across all incorporated RCTs. A value of I^2 exceeding 50.0% or a *p*-value below 0.10 was indicative of significant heterogeneity.[20] In scenarios where substantial statistical heterogeneity was identified, a random-effects model was employed instead of a fixed-effects model, ensuring accurate assessment.

Furthermore, a sensitivity analysis was performed using Stata 17.0 software. This analysis involved the sequential exclusion of each study to gauge the stability of the overall results. A subgroup analysis was carried out to explore the impact of different exercise modes.

3 | RESULTS

3.1 | Study selection and characteristic

After completing the search strategy, a total of 1,584 articles were obtained and identified as qualifications of inclusion criteria. One thousand one hundred seventy-two of them remained to review after removing 412 duplicate records. Two reviewers independently read the title and abstract of each included record using Endnote 20 software based on the inclusion and exclusion criteria. Seventeen articles were obtained and a full-text screen of these articles was conducted. After the full-text screen, ten articles were excluded. The excluded reasons were as follows: non-RCT ($n = 1$), the PDE5i therapy contained in exercise, or control group ($n = 5$), and the patients who underwent radical prostatectomy ($n = 4$). Finally, a total of seven RCTs were included and analyzed (Figure 1 and Table 1).

A total of 470 adult men diagnosed with ED were encompassed within this comprehensive meta-analysis. The majority of participants were middle-aged or older adults. There were many etiologies of ED, including obesity,[21,22] arterial ED,[23] hypertension,[24] androgen deficiency,[25] stroke,[26] and ischaemic heart disease or implantable cardioverter defibrillator.[27]

3.2 | Quality assessment of included studies

Comprehensive insights regarding the potential bias risks were meticulously illustrated in Figures 2 and 3, utilizing the Cochrane risk of bias tool for rigorous assessment. Notably, a significant proportion of the studies (4 of 7) offered transparent and comprehensive details concerning the random sequence generation process. However, for the aspect of allocation concealment, three studies omitted reporting, thereby warranting an evaluation of "unclear." Given the nature of the interventions, blinding of participants and personnel was deemed unfeasible across the included studies. Among the studies, 4 out of 7 were categorized as exhibiting a high risk in this domain, while one study remained categorized as "unclear." In the context of outcome assessment blinding, three studies were marked as "unclear" and one study was assigned a high risk. Importantly, in the sphere of incomplete outcome reporting, three RCTs demonstrated a high risk of bias. Moreover, across all studies, a consistent pattern emerged, with all studies displaying a low risk in the domain of selective outcome reporting.

3.3 | Meta-analysis of physical activity on erectile dysfunction

Figure 4 portrays the forest plot encapsulating the overall impact of physical activity on the enhancement of ED in adult men. This quantitative synthesis encompasses a total of seven RCTs involving 470 adult male patients. Spanning a range from 0.03 to 1.59, the SMDs were subject to rigorous evaluation. The calculated SMD using the random-effects model was 0.69 (95% CI 0.37 to 1.02, $p < 0.0001$). Significant heterogeneity was observed, as indicated by the Cochrane *Q* statistic and I^2 statistic ($p = 0.03$, $I^2 = 58\%$).

3.3.1 | Subgroup analysis

Subgroup analysis revealed notable distinctions in exercise modes. Figure 5 elucidates the outcomes derived from this detailed subgroup analysis. Concerning exercise modes, the classifications encompassed the following categories: aerobic training alone ($n = 4$), PFMT ($n = 1$), and aerobic training combined with resistance training ($n = 2$). The results indicated that aerobic training alone (SMD 0.81; 95% CI 0.56 to 1.06; $p < 0.00001$) led to a significant elevation in IIEF scores. Notably, aerobic training alone exhibited low heterogeneity ($p = 0.27$, $I^2 = 23\%$). In contrast, PFMT (SMD 0.03; 95% CI −0.68 to 0.75; $p = 0.93$) and the combination of aerobic and resistance training

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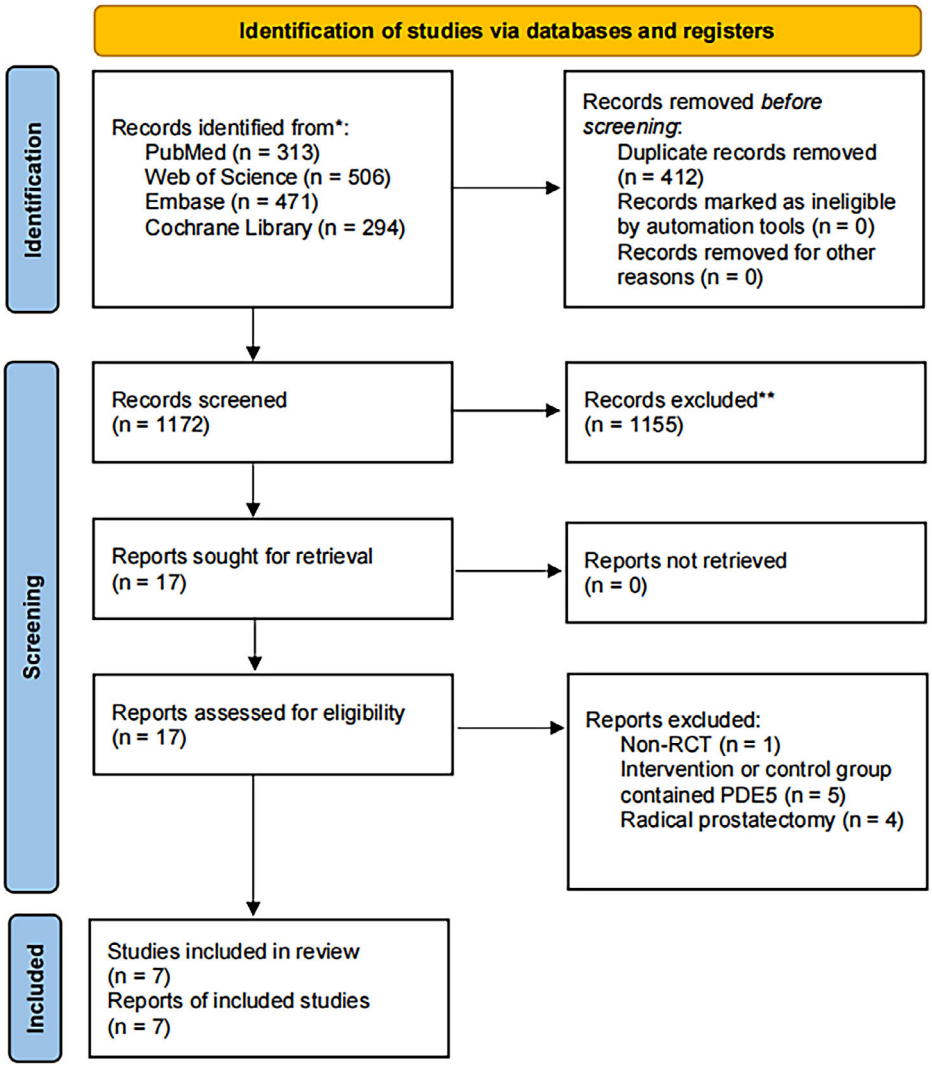
Identification of studies via databases and registers
Identification
Records identified from*:
PubMed (n = 313)
Web of Science (n = 506)
Embase (n = 471)
Cochrane Library (n = 294)
Records removed before screening:
Duplicate records removed (n = 412)
Records marked as ineligible by automation tools (n = 0)
Records removed for other reasons (n = 0)
Screening
Records screened (n = 1172)
Records excluded** (n = 1155)
Reports sought for retrieval (n = 17)
Reports not retrieved (n = 0)
Reports assessed for eligibility (n = 17)
Reports excluded:
Non-RCT (n = 1)
Intervention or control group contained PDE5 (n = 5)
Radical prostatectomy (n = 4)
Included
Studies included in review (n = 7)
Reports of included studies (n = 7)

FIGURE 1 Flow diagram of the selection of studies.

showed no augmentation in IIEF scores (SMD 0.84; 95% CI −0.41 to 2.09; $p = 0.19$).

3.3.2 | Sensitivity analysis

To gauge the robustness of the meta-analysis findings, a sensitivity analysis was systematically carried out, entailing the exclusion of each study. The outcomes of this analysis are visually depicted in Figure 6. Across the spectrum of studies excluded, the I^2 value exhibited a range of 47%–65%, while consistently maintaining statistical significance with *p*-values. Overall, the sensitivity analysis result of this meta-analysis was robust.

4 | DISCUSSION

Our study conducted a comprehensive review of seven available studies, all of which were subsequently included in our meta-analysis. The findings from this analysis suggest a positive correlation between physical activity and improved IIEF scores in ED patients who not receiving the PDE5i therapy and have not undergone radical prostatectomy. Nevertheless, it is important to approach the results of this meta-analysis with caution, primarily due to the statistical heterogeneity observed among the studies. In subgroup analysis, our results indicated that aerobic training alone exhibits effectiveness in improving the erectile function in this population, which is in accord with the previous studies. However, when it comes to PFMT or a combination of aerobic and resistance training, our analysis did not reveal significant effectiveness for patients with ED.

The physical activity is considered one of the protected factors for ED.[28–30] Two previous systematic reviews and meta-analyses have reported the relationship between the physical activity and ED in adult men, which acquired similar results from our study.[17,18] However, there are some improvements in our study, referring to data selection and statistical analysis compared to previous meta-analyses. First, the two previous meta-analyses focused on the overall effect of the physical activity,[17] and the effect of aerobic training on ED.[18] We

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TABLE 1 Characteristics of included RCTs.

Study	Number of patients at baseline and endpoint	Predisposing factor	Age (mean±SD or range)	Control group	Exercise group	Measurement duration from baseline	Measurement tools	Mean IIEF score at baseline (SD or range)
Esposito2004	CG: 55 EG: 55	Obesity	CG: 43 ± 5.1 EG: 43.5 ± 4.8	General information about healthy food choices and exercise, without specific individualized program	2 years, lose weight advice (caloric intake) and increasing physical activity (walking, swimming, or aerobic games)	2 year	IIEF items 1–5	CG: 13.5 ± 4.0 EG: 13.9 ± 4.0
Ismail2024	CG: 30 EG: 30	Chronic plaque psoriasis, metabolic syndrome, obesity	CG: 44.80 ± 3.17 EG: 44.03 ± 3.59	Lifestyle habits unchanged	12 weeks, 3 times weekly The warm-up and cool-down phases involved 5 min each of walking at 40-50% of the participants' maximum heart rate, followed by a 30 min walking session on the treadmill at 60%–70% of their maximum heart rate	12 weeks	IIEF-5	CG: 17.23 ± 3.66 EG: 16.13 ± 3.70
Kalka2013	CG: 35 EG: 103	Invasively treated ischaemic heart disease	CG:61.43 ± 8.81 EG:62.07 ± 8.59	Received general health information	6 months, each week contained 5 days of cardiac rehabilitation (45 min interval endurance training on a cycle ergometer, intensity at 40%–70% workload), 2 days of general fitness exercises and resistance training (8–10 types of endurance exercises, 12–15 repetitions each series)	6 months	IIEF-5	CG: 12.26 ± 5.83 EG: 12.51 ± 5.98
La Vignera2011	CG: 20 EG: 50	Arterial ED	CG: 55.8 ± 1.2 EG: 57.3 ± 0.5	Only conducted the Mediterranean diet	3 months, 150 min moderate intensity (40-60% maximum heart rate) aerobic activity per week, each about 30 min, combined with the Mediterranean diet	3 months	IIEF-5	CG: 10.5+3.13 EG: 11.0+7.07
Lamina2009	CG: 21 EG: 22	Hypertension	CG:64.00 ± 4.77 EG:62.10 ± 5.23	Remained sedentary+methyldopa (250 and 500 mg daily)	8 weeks, 3 sessions per week, 45–60 min each session, exercise on a bicycle ergometer at 60%–79% maximum heart rate+methyldopa (250 and 500 mg daily)	8 weeks	IIEF	CG: 8.1+4.02 EG: 11.5+5.3

(Continues)

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TABLE 1 (Continued)

Study	Number of patients at baseline and endpoint	Predisposing factor	Age (mean±SD or range)	Control group	Exercise group	Measurement duration from baseline	Measurement tools	Mean IIEF score at baseline (SD or range)
Leitao2021	CG: 12 EG: 7	Androgen deficiency	47.38 ± 5.03	Placebo (starch)	6 months, 3 sessions per week, each session including 30 min of aerobic exercises on the treadmill and 30 min resistance training at an intensity of 40-55% 1RM. In the last month, the protocol changed to 10 min of aerobic exercises with nearly maximum intensity and 50 min of resistance training with a load of 80%−90% 1RM+ placebo (starch)	1, 4, 6 months	IIEF-EF (items 1−5+15)	CG: 19.5 ± 2.1 EG: 20.5 ± 2.57
Tibaek2015	CG: 15 EG: 15	Stroke	Median age: 68 years; Interquartile range: 60−74 years	Normal, standard program of general rehabilitation	12 weeks PFMT Home Exercises, near-maximal contractions, 1-2 times daily (6 s contractions followed by 6 s rests) Group treatments, isolated PFM contractions (6 s contractions followed by 6 s rests), strength exercises (3 s contractions followed by 3 s rests, and 6 s contractions followed by 6 s rests), and endurance exercises (up to 30 s sub-maximal contractions followed by 30 s rests).	12 weeks, 6 months	IIEF-5	CG: 14.91 ± 15.54 EG: 15.46 ± 15.54

Abbreviations: CG, control group; EG, exercise group; IIEF-5, the 5-item version of the International Index of Erectile Function; IIEF-EF, erectile function domain of the International Index of Erectile Function; PFM, pelvic floor muscle; PFMT, pelvic floor muscle training; SD, standard deviation.

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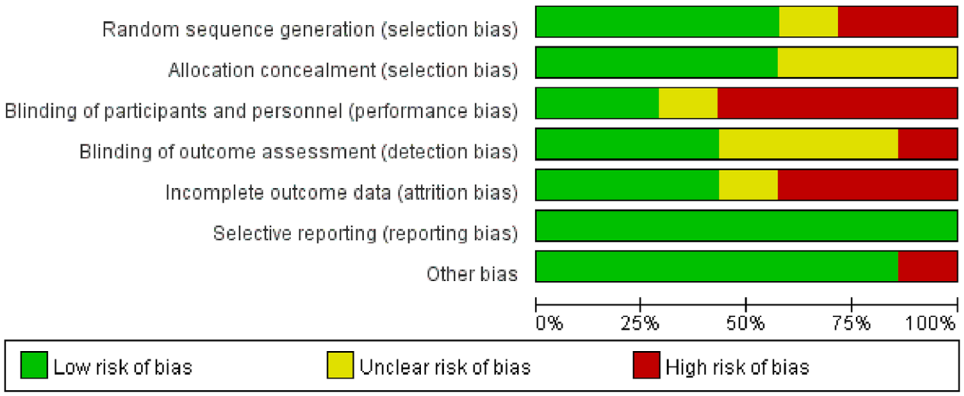

FIGURE 2 Risk of bias graph.

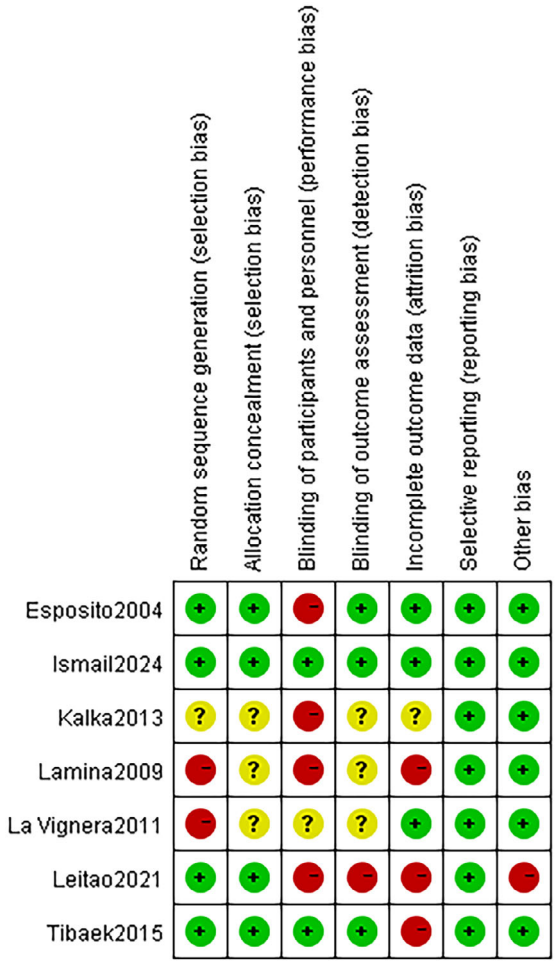

FIGURE 3 Risk of bias summary.

categorized physical exercise into different modes including aerobic training alone, PFMT, and aerobic combined with resistance training, exploring the effectiveness of different exercises on improving the erectile function in patients with ED, which is the first to conduct. Second, the two previous meta-analyses did not exclude patients using the PDE5i treatment. We excluded studies using PDE5i. The reason is that the efficacy of PDE5i in treating ED is widely recognized,[13] including such studies may potentially influence the assessment of the effectiveness of physical activity interventions for patients with ED. Third, the two previous meta-analyses did not exclude patients who underwent radical prostatectomy. We excluded studies involving patients who underwent radical prostatectomy. ED is a common postoperative outcome of radical prostatectomy.[31] Even without engaging in the physical activity, ED in patients undergoing radical prostatectomy may potentially improve over time,[32,33] which could influence the results of this study. Fourth, previous meta-analyses utilized MD for calculations. Given that the included studies utilized three types of IIEF assessment tools, including IIEF (total score of 75 points), IIEF-5 (total score of 25 points), and IIEF-EF (total score of 30 points), it may be more plausible for our study to use SMD to analyze the effects of physical activity on ED compared to previous studies using MD.

Our study findings revealed a significant enhancement in the male erectile function through aerobic training, with low heterogeneity ($I^2 = 23\%$), further indicating the reliability of the results. Notably, in our subgroup analysis, three out of four RCTs reported the positive effect of moderate to vigorous intensity aerobic exercise in patients with ED.[22–24] This aerobic training regimen targeted heart rates from 40% to 79%, 3–5 sessions per week (120–180 min/week). Similarly, a study indicated that high-volume (200–300 min/week) moderate-intensity exercise leads to more pronounced improvements in the erectile function compared to low-volume (< 150 min/week) regimes.[34] Therefore, a high-volume aerobic training regimen with moderate to vigorous intensity may be an appropriate method to enhance the erectile function, supported by existing evidence. A prior review suggested the potential effectiveness of resistance training in addressing ED.[35] However, our subgroup analysis did not reveal the effectiveness of aerobic combined with resistance training, a phenomenon potentially attributable to the limited number of studies available. This underscores the need for further exploration through additional investigations.

Furthermore, our subgroup analysis, which was based on only one study, indicated that PFMT did not lead to a significant improvement in the erectile function among adult male patients with ED who did not use PDE5i and did not undergo radical prostatectomy. Despite a

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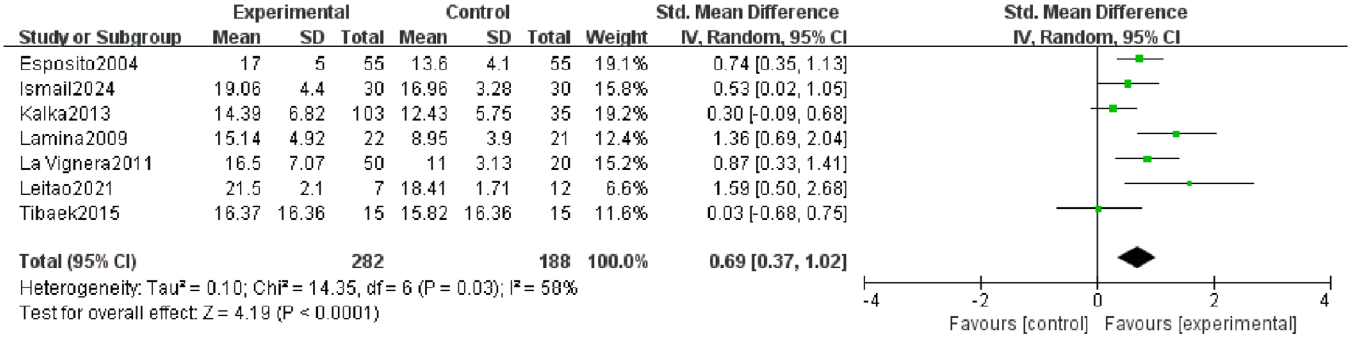

FIGURE 4 Meta-analysis of the physical activity on erectile dysfunction.

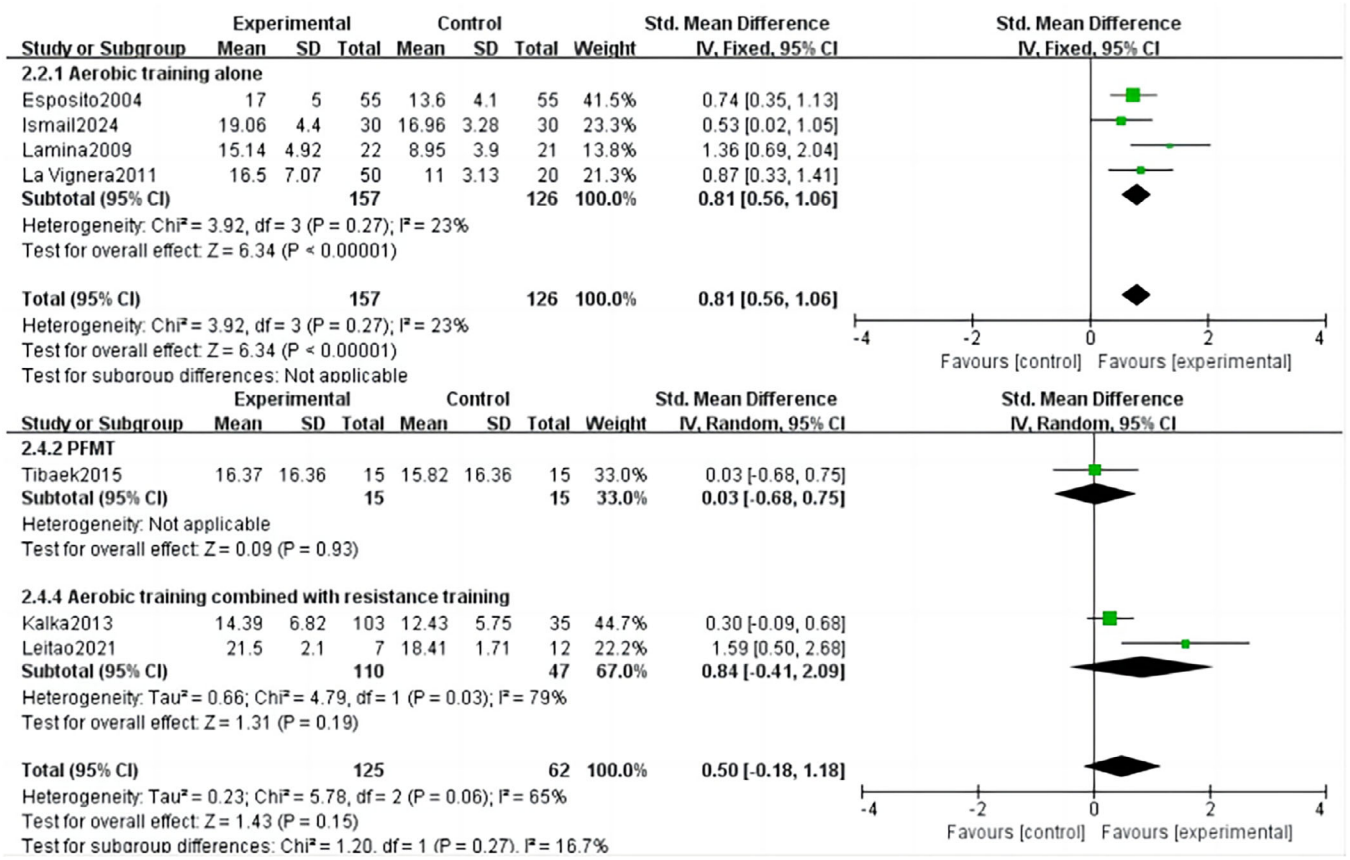
Experimental
Control
Std. Mean Difference
Std. Mean Difference
Study or Subgroup Mean SD Total Mean SD Total Weight IV, Fixed, 95% CI
IV, Fixed, 95% CI
2.2.1 Aerobic training alone
Esposito2004 17 5 55 13.6 4.1 55 41.5% 0.74 [0.35, 1.13]
Ismail2024 19.06 4.4 30 16.96 3.28 30 23.3% 0.53 [0.02, 1.05]
Lamina2009 15.14 4.92 22 8.95 3.9 21 13.8% 1.36 [0.69, 2.04]
La Vignera2011 16.5 7.07 50 11 3.13 20 21.3% 0.87 [0.33, 1.41]
Subtotal (95% CI) 157 126 100.0% 0.81 [0.56, 1.06]
Heterogeneity: Chi² = 3.92, df = 3 (P = 0.27); I² = 23%
Test for overall effect: Z = 6.34 (P < 0.00001)
Total (95% CI) 157 126 100.0% 0.81 [0.56, 1.06]
Heterogeneity: Chi² = 3.92, df = 3 (P = 0.27); I² = 23%
Test for overall effect: Z = 6.34 (P < 0.00001)
Test for subgroup differences: Not applicable
-4 -2 0 2 4
Favours [control] Favours [experimental]
Experimental
Control
Std. Mean Difference
Std. Mean Difference
Study or Subgroup Mean SD Total Mean SD Total Weight IV, Random, 95% CI
IV, Random, 95% CI
2.4.2 PFMT
Tibaek2015 16.37 16.36 15 15.82 16.36 15 33.0% 0.03 [-0.68, 0.75]
Subtotal (95% CI) 15 15 33.0% 0.03 [-0.68, 0.75]
Heterogeneity: Not applicable
Test for overall effect: Z = 0.09 (P = 0.93)
2.4.4 Aerobic training combined with resistance training
Kalka2013 14.39 6.82 103 12.43 5.75 35 44.7% 0.30 [-0.09, 0.68]
Leitao2021 21.5 2.1 7 18.41 1.71 12 22.2% 1.59 [0.50, 2.68]
Subtotal (95% CI) 110 47 67.0% 0.84 [-0.41, 2.09]
Heterogeneity: Tau² = 0.66; Chi² = 4.79, df = 1 (P = 0.03); I² = 79%
Test for overall effect: Z = 1.31 (P = 0.19)
Total (95% CI) 125 62 100.0% 0.50 [-0.18, 1.18]
Heterogeneity: Tau² = 0.23; Chi² = 5.78, df = 2 (P = 0.06); I² = 65%
Test for overall effect: Z = 1.43 (P = 0.15)
Test for subgroup differences: Chi² = 1.20, df = 1 (P = 0.27), I² = 16.7%
-4 -2 0 2 4
Favours [control] Favours [experimental]

FIGURE 5 Subgroup analysis of exercise modes.

notable increase in IIEF-5 scores observed within the exercise group following PFMT, this increase did not achieve statistical significance compared to the control group.[26] However, another systematic review indicated that PFMT contributes to enhanced premature ejaculation and the erectile function in adult men with ED and no history of neurological injury or prior major urological surgeries,[36] which differs from our result. A limited number of included studies and ED patients, as well as the intensity and volume of PFMT may be the reasons for the inconsistent results. The research showed that PFMT effectively strengthens the superficial pelvic floor muscles, including the bulbospongiosus, ischiocavernosus, and transverse perineal muscles, enhancing intracavernous pressure and blood flow to the distal penis, thus improving erection.[37,38] PFMT could be potentially effective training for adult male patients with ED who did not use PDE5i and undergo radical prostatectomy, but further research is still needed.

5 | LIMITATION

One limitation of this systematic review and meta-analysis is our inability to conduct subgroup analysis based on different etiologies of ED and age group, due to the limited number of included studies.

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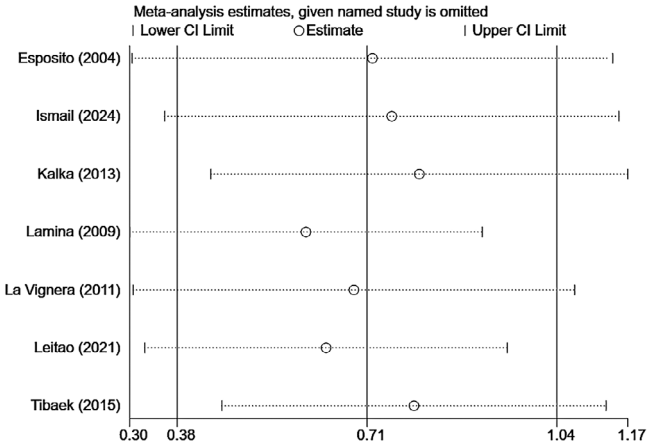

FIGURE 6 Sensitivity analysis of the physical activity on erectile dysfunction.

Additionally, the presence of substantial heterogeneity represents another limitation. Despite our efforts to address this by conducting subgroup and sensitivity analyses, the results of this meta-analysis still need to be approached with caution. Meanwhile, different measurement tools, such as IIEF, IIEF-5, and IIEF-EF, were used in the included studies. The three tools exhibit nuanced differences in their respective emphases and focal points, which lead to potential heterogeneity. The IIEF comprises a 15-item questionnaire that encompasses five domains of the male sexual function: erectile function, orgasmic function, sexual desire, intercourse satisfaction, and overall satisfaction.[39] The IIEF-5, a condensed questionnaire, primarily focuses on the erectile function and intercourse satisfaction.[40] The IIEF-EF, on the other hand, specifically assesses the erectile function.

Consequently, further experimental studies are warranted to explore the most effective exercise approaches for various etiologies of ED, encompassing different exercise modes, volumes, and intensities, and the improvement effects of exercise on ED in males across different age groups. Furthermore, there is a need for investigations into the potential benefits of PFMT and resistance combined aerobic training for treating ED.

6 | CONCLUSION

In summary, the physical activity could offer potential benefits for adult male patients with ED and not receiving the PDE5i therapy, particularly when considering aerobic exercises alone. However, PFMT and a combination of aerobic and resistance training did not demonstrate significant improvement in the erectile function among patients with ED.

AUTHOR CONTRIBUTIONS

Zihao Chen and Jiayuan Tu conceived and planned the review, assessed the methodologic quality of the studies, verified the data, and drafted and revised the manuscript. Junqiang Jia, Jiaxin Wang and Chunhui Wu conducted the literature search and selected studies. Jiayuan Tu and Jiulong Song provided methodologic advice, content expertise, and revised the manuscript. All authors contributed to writing the protocol. All authors read and approved the final manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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DATA AVAILABILITY STATEMENT

Data on search results, study selection, data collection and quality assessment available on request.

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